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Project Title: Usable Translational Hand Controllers for NASA's Habitability Design Center

Abstract:

This summer I was given the opportunity to work at the Habitability Design Center (HDC). NASA Johnson Space Center's HDC is currently developing Cislunar and Mars spacecraft mockups. I contributed to this effort by designing from scratch low cost, functional translational hand controllers (THCs) that will be used in spacecraft mission simulation in low to medium fidelity exploration spacecraft mockups.

This project fell under the category of mechatronics, a combination of mechanical, electrical, and computer engineering. Being an aerospace engineering student, I was out of my comfort zone. And that was a wonderful thing. The autonomy that my mentor, Dr. Robert Howard, allowed me gave me the opportunity to learn by trying, failing, and trying again. This project was not only a professional success for me, but a significant learning experience. I appreciated the freedom that I had to take the time to learn new things for myself rather than blindly follow instructions.

I was the sole person working on this project, and was required to work independently to solve the many hardware and software challenges that the project entailed. I researched THCs that have been used on the ISS, the Space Shuttle, and the Orion MPVC and based my design off of these. I worked through many redesigns before finding an optimal configuration of the necessary mechanisms and electrical components for the THC.

Once I had a functional hardware design, I dove into the challenge of getting an Arduino Uno, an extremely low cost and easily programmable microcontroller, to behave as a human interface device. The THCs I built needed to be able to integrate to a mission simulation designed by NASA's Graphics and Visualization Lab. This proved to be the most challenging aspect of the project. To accomplish this I learned how to change the firmware of the USB serial converter microcontroller. The process was very complicated as it involved multiple software programs and manual flashing of pins on the Arduino itself. When I successfully achieved the goal I wrote an instructions manual for the process so that the HDC will be able to do this easily in the future for any human interface device they may want to create. I also created a detailed CAD model of my THC design with construction instructions.

My THC utilizes three ultrasonic sensors, one for each axis of motion. I wrote a code that stimulates these sensors continuously and feeds back values from each axis ranging from -%100 to %100 of the min/max position in relation to the neutral position of each axis. This was the data that the Graphics and Visualization Lab required to interface with their simulation.

I truly enjoyed working in the HDC surrounded by passionate, proactive, and brilliantly creative people. I felt valued and respected as a part of their team. I was given the time and support of my mentor whenever I asked for it. Beyond my positive project experience, I was fortunate enough to be able to take advantage of many of the extra activities that JSC has to offer. I took Russian Phase One during my lunch break every day and can now read Russian and accomplish basic verbal communication. I was heavily involved with the co-tern music video, which led to numerous incredible experiences and friendships. I saw every facility, attended every lecture, and met everyone that I could. I had coffee with Lauri Hansen. I played on an intern volleyball team at the Gilruth. I traveled to Michoud, Stennis, NOLA, and Big Bend National Park. I had the time of my life and I fell in love with JSC.

In the next month I will return to Maryland and start my senior year of my undergraduate degree. As I work through it I will remember that all of the studying I do, all of the concentration I give, and all of the sacrifices that I make for school are so that I can work at a place like JSC where I am proud and excited to go into work every day. This internship was an invaluable experience for me, both professionally and personally.